Adipose tissue fatty acid and lipid mediator composition in obesity and response to chronic marine omega-3 fatty acid supplementation

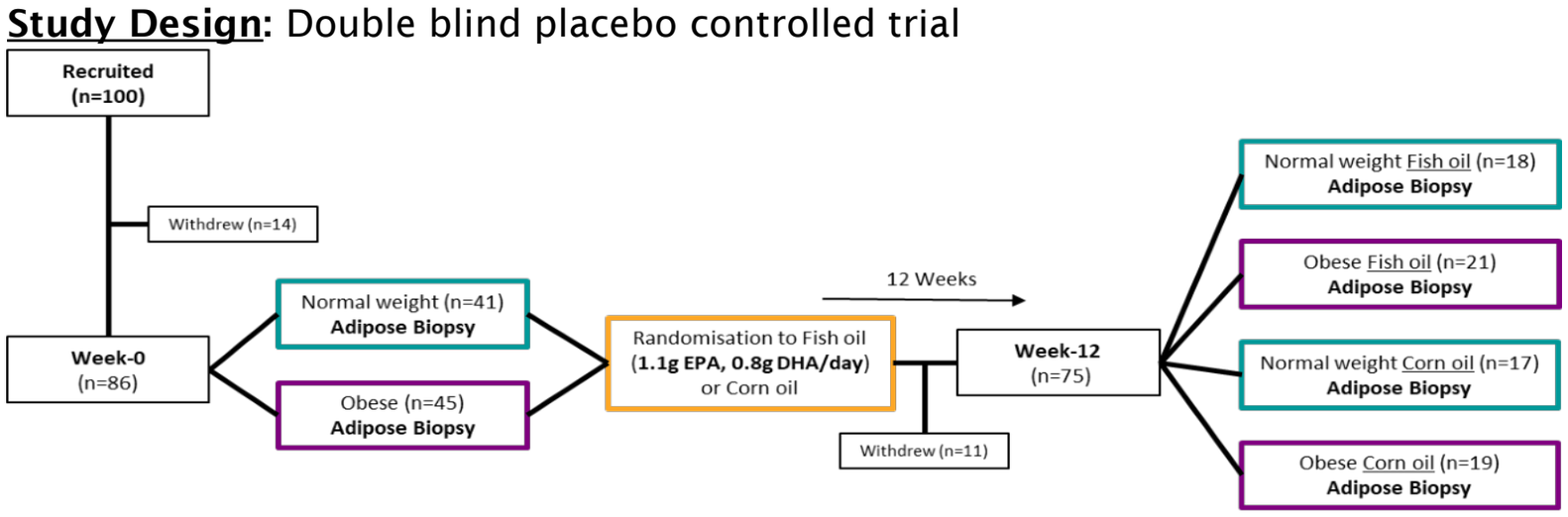
University of Southampton
Ethical Approval number 11/SC/0384
Funding by the European Commission

Fisk HL[1], Ayres R[1], Childs CE[1], Kuda O[2], Kopecky J[3] and Calder PC[1].
[1] Human Development and Health Academic Unit, Faculty of Medicine, University of Southampton, Southampton, UK. [2] Department of Adipose Tissue Biology, Institute of Physiology of the Czech Academy of Sciences, Prague, Czech Republic. [3]Institute for Clinical and Experimental Medicine, Prague, Czech Republic.

Introduction:
Obesity alters normal metabolism and endocrine functions of adipose tissue (AT) which results in secretion of fatty acids (FA) and altered levels of FA metabolites, termed lipid mediators, which play a role in inflammation, energy homeostasis and tissue development in the AT. Altered concentrations of plasma lipid mediators have been reported in obesity but investigations in human AT are lacking. The omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) occur naturally in fatty fish and fish oil and have been widely studied for their anti-inflammatory effects. They have been shown to reduce inflammation in human AT in a small number of previous studies but few detail the effect of EPA and DHA on human AT FA composition with consideration of BMI or have compared this to the response of AT lipid mediators in humans.

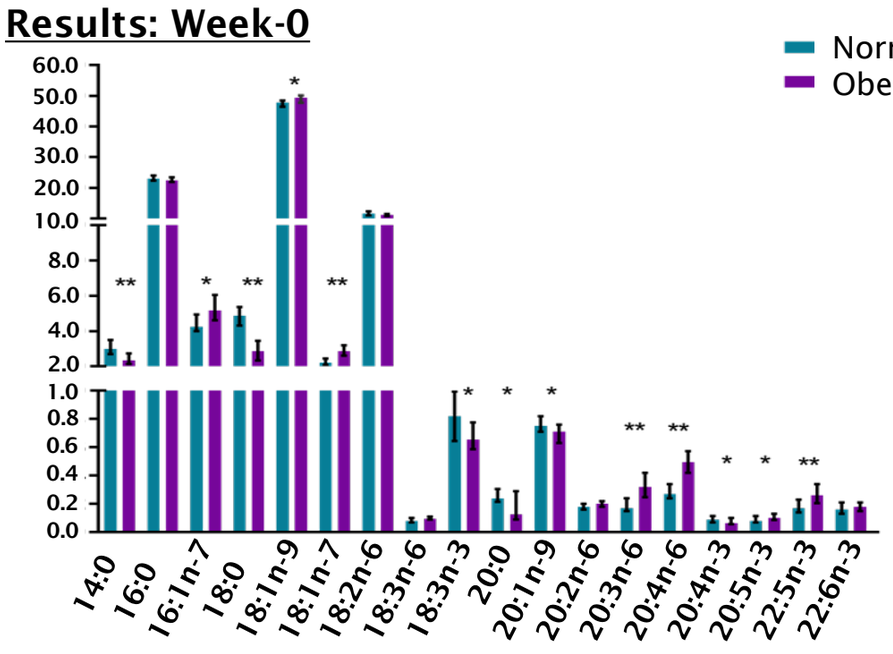
Objectives: To investigate whether obesity is associated with an altered AT FA and lipid mediator composition, and whether obesity is associated with altered responses in these parameters following 12-week fish oil (FO) (EPA+DHA) supplementation.

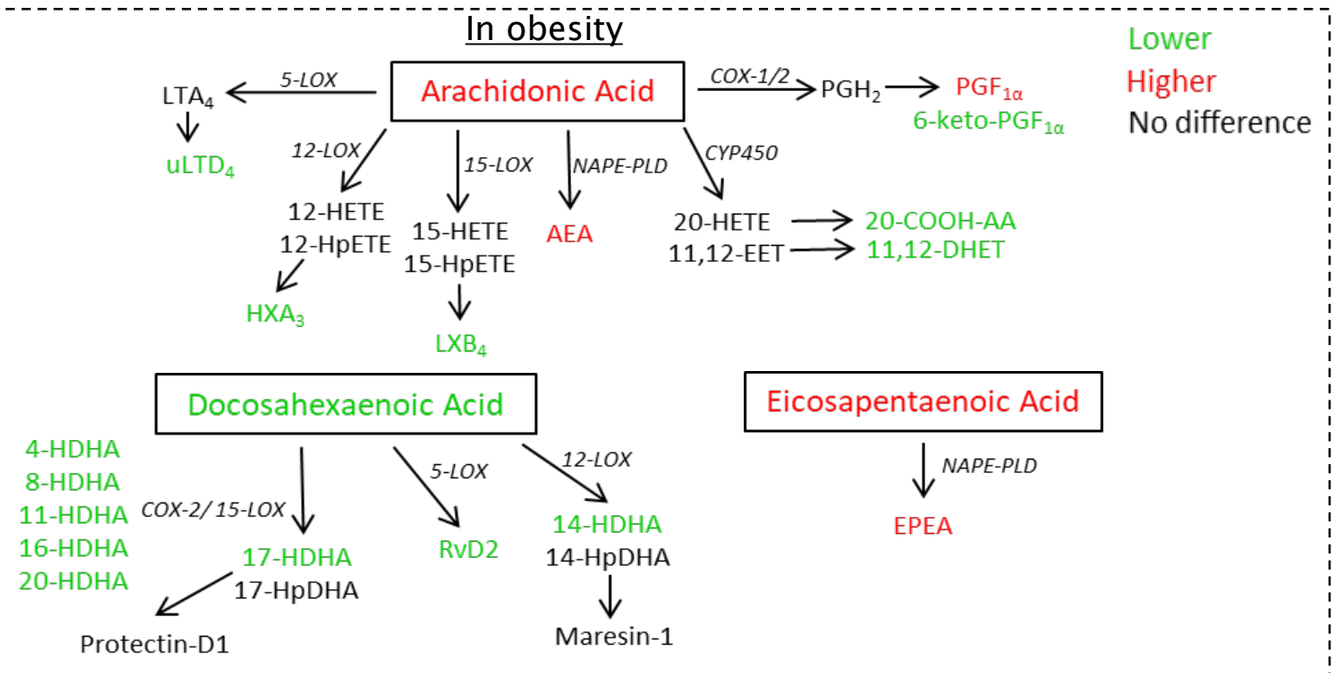
Study Design: Double blind placebo controlled trial



Methods: The proportional composition of FA and the concentration of lipid mediators, in the total lipid extract of abdominal subcutaneous white AT obtained from normal weight (NW) and metabolically healthy obese (OB) individuals at Week-0 and Week-12 following FO (EPA + DHA) or Corn oil intervention, were assessed by gas chromatography and ultra pure liquid chromatography - tandem mass spectrometry (UPLC-MS/MS) respectively.

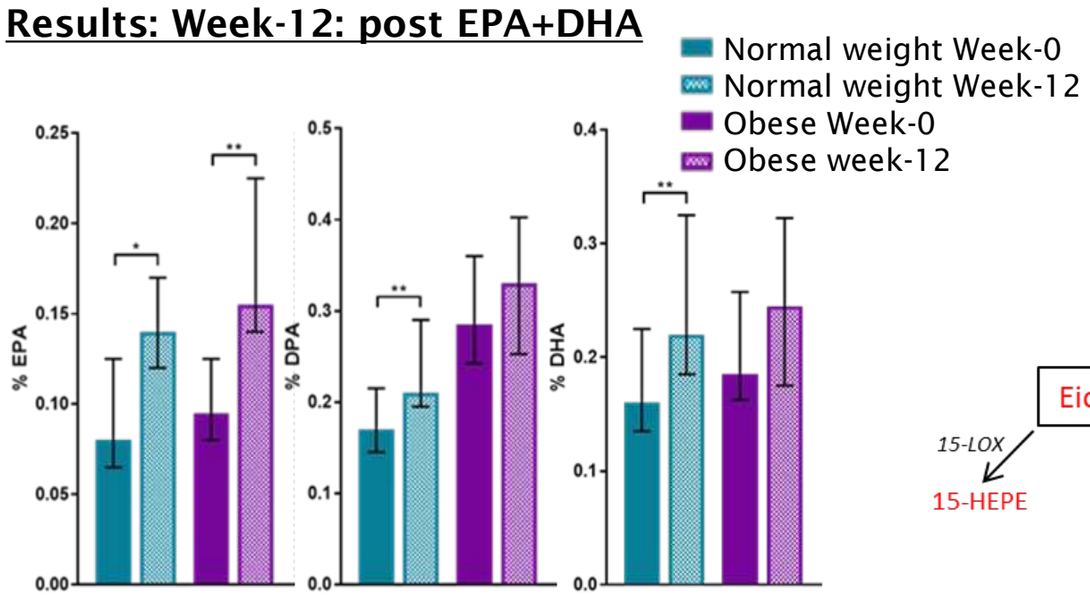
Results: Week-0



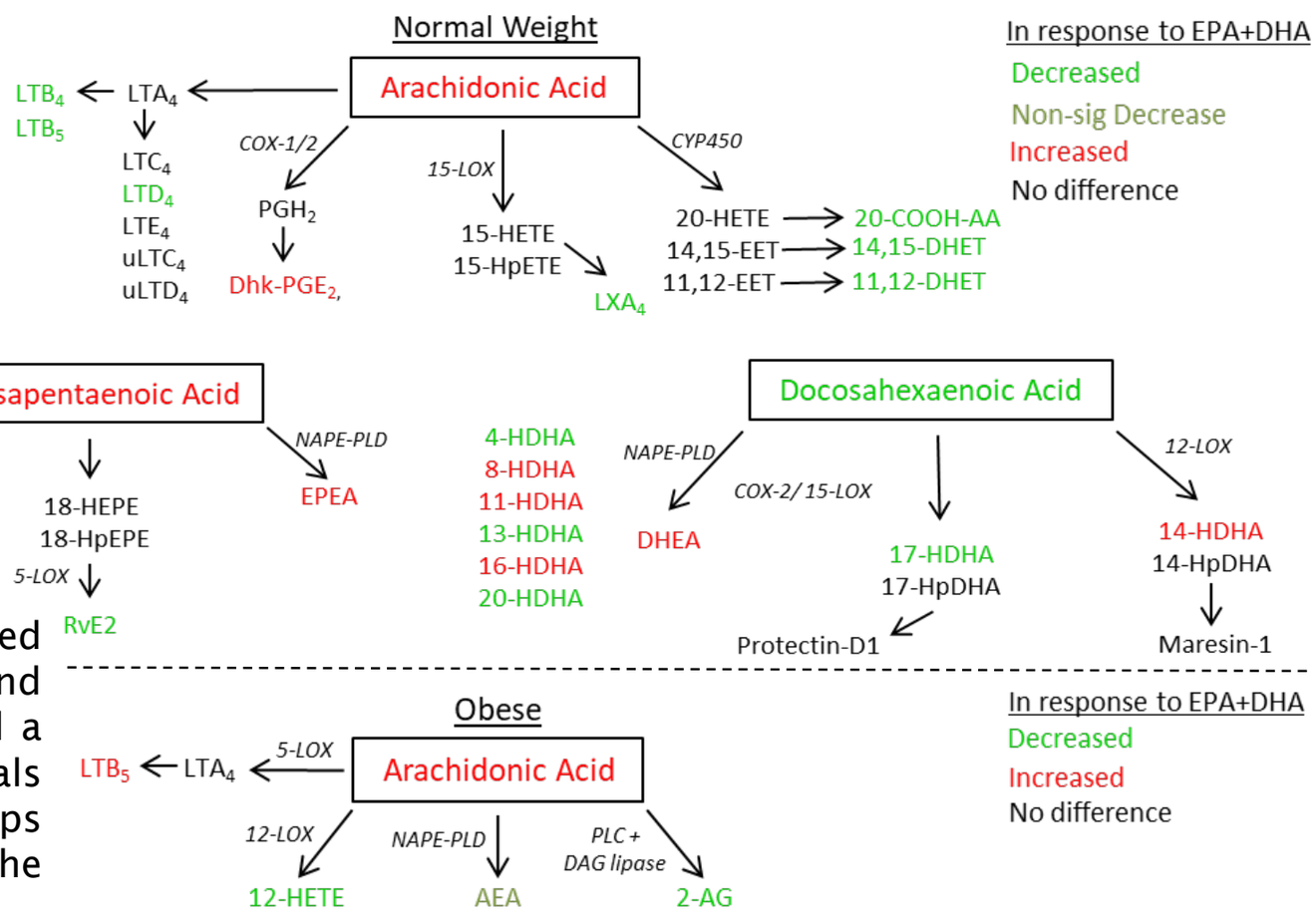


Obesity was associated with higher proportions of MUFAs, arachidonic acid (AA), EPA and DPA, and lower SFAs ($P \leq 0.05$) Obesity was also associated with lower concentrations of many DHA derived metabolites and higher endocannabinoids ($P \leq 0.05$)

Results: Week-12: post EPA+DHA



Chronic supplementation with FO significantly increased concentrations of AT EPA in both BMI groups, and DPA and DHA in normal weight individuals ($P \leq 0.05$). FO increased a range of EPA and DHA derived metabolites in NW individuals and decreased AA derived metabolites in both BMI groups with more profound effects seen in NW individuals and on the endocannabinoid system ($P \leq 0.05$).



Discussion and conclusions: Both the FA and FA metabolite composition of AT was altered in obesity at baseline and is suggestive of enhanced inflammation in the context of tissue expansion and inhibition of self resolution. EPA and DHA were incorporated into AT to a similar extent in NW and OB individuals in response to EPA+DHA intervention. This resulted in increased EPA and DHA derived mediators in NW and decreased AA derived mediators in both NW and OB individuals with the most profound effects observed in NW individuals and on the EC system. The mechanisms behind these differences in FA metabolism and lipid mediator synthesis, particularly ECs, between NW and OB individuals at baseline, as well as in response to FO supplementation are unclear and require further investigation. **Future work** includes measuring activity of key enzymes in lipid mediator metabolic pathways.